

## Toxics in Fish

Toxic pollutants in our bays, rivers, and streams can show up in the fish that live there, causing them to become diseased and posing a health threat to us when we eat the fish. Pollutants in the Puget Sound ecosystem include several important classes of chemicals including, PCBs, PBDEs, PAHs, and Endocrine Disrupting Compounds.

Concern over these chemicals in Puget Sound is high because they are toxic, they last for a long time in the ecosystem, and their levels increase in predators as the chemicals move up the food chain, a process called biomagnification. Measuring these pollutants in fish tissues tells us whether present-day levels are harmful to the fish or the predators that consume them and whether they are safe for us to eat.

Scientists have been tracking contaminant levels in Puget Sound fish since 1989 and have established threshold limits for these chemicals in fish tissues. These thresholds give us a guideline for the level of toxic chemicals that fish can tolerate, before they become diseased or show other harmful effects.

## Toxics in Fish

### INDICATOR:

- 1) Levels of four types of toxic contaminants in several species of fish
- 2) Contaminant-related disease in fish

Indicator lead: Jim West, Washington Department of Fish and Wildlife

### TARGET:

Target 1) By 2020, contaminant levels in fish will be below health effects thresholds (i.e. levels considered harmful to fish health, or harmful to the health of people who consume them)

Target 2) By 2020, contaminant-related disease or impairments in fish are reduced to background levels

### Contaminant Type 1

#### Polychlorinated Biphenyls (PCBs)

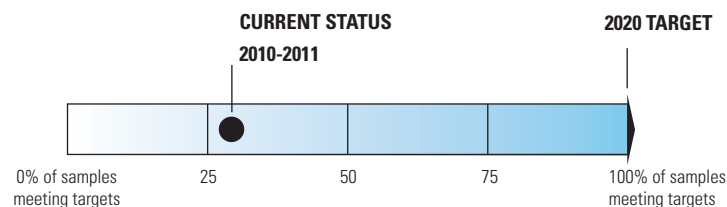
### PROGRESS:

IS THE  
TARGET MET?

**NO**

IS THERE  
PROGRESS?

**NO**



PCBs exceeded health effects thresholds or have been identified as a risk to seafood consumers in recent years for (1) urban English sole, (2) adult Chinook salmon returning to Puget Sound rivers, (3) juvenile Chinook salmon in Puget Sound or its river mouths, and (4) Pacific herring in Southern and Central Puget Sound. There has been no significant decline in PCBs in these species for the period monitored. However, adult coho salmon returning to Puget Sound rivers were below thresholds.

## Progress Towards 2020 Targets

Of the four classes of toxic chemicals being tracked and reported on, one (polybrominated diphenyl ethers) show signs of progress, two (polychlorinated biphenyls and polycyclic aromatic hydrocarbons) show no change, and for one of the four (endocrine disrupting chemicals) there is not enough information to determine if progress is being made. The full 2020 target language for toxics in fish that was adopted by the Leadership Council is complex, relating four different classes of chemical contaminants to three different types of fish (herring, English sole, and salmon/steelhead), with four different concentration thresholds that range from no adverse effects to

### Contaminant Type 2

#### Flame Retardants (polybrominated diphenyls, or PBDEs)

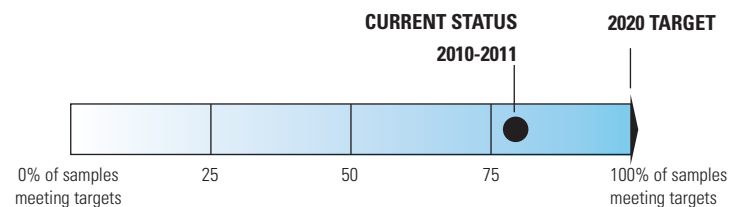
### PROGRESS:

IS THE  
TARGET MET?

**NO**

IS THERE  
PROGRESS?

**YES**



Evaluation of PBDEs is challenging because health effects thresholds are not yet available for some species. However, it appears that in most species levels are at or below obvious, immediate concern for most areas. In addition, PBDE levels appear to be declining in Pacific herring from Central and Southern Puget Sound.

no toxics-related reproductive impairment.

Making progress towards 2020 targets requires identifying which chemicals are most problematic, and then controlling their sources or cleaning up pollutants that have accumulated in the environment.

The danger of some chemicals (such as PCBs) was identified, and source controls imposed, over thirty years ago. PCB levels in Puget Sound fish today are probably ten times lower than they were in the 1970s, but they have not changed appreciably in the past 20 years. Current PCB levels are high enough to trigger Department of Health consumption advisories for Chinook salmon and other species, and are probably still high enough to harm fish health. Further reduction of PCBs in the ecosystem will likely require a combination of activities, including cleaning up contaminated sediments, identifying and halting new sources of PCBs into the system, and waiting for

existing PCBs in the system to degrade or become unavailable.

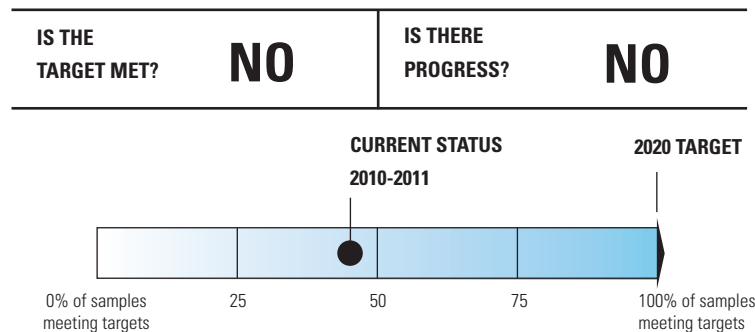
Some progress towards 2020 targets for PBDEs has been made. The danger of flame retardants (polybrominated diphenyl ethers, or PBDEs) was recognized relatively recently, and source controls have been imposed. These include a legislated ban on the use of certain PBDE compounds and voluntary reduction in production of other compounds by industry. Although it is unclear whether these actions were responsible, PBDEs have been declining in one monitored species, Pacific herring, from Central and Southern Puget Sound, to levels that are likely below cause for concern.

Progress related to hydrocarbons (polycyclic aromatic hydrocarbons, or PAHs) has been mixed. This is probably related to the huge range of sources for these compounds (they come from petroleum, and from burning fossil fuels), and the difficulty in controlling such pervasive sources. Some

#### Contaminant Type 3

#### Hydrocarbons (products of petroleum or combustion; polycyclic aromatic hydrocarbons, or PAHs)

##### PROGRESS:

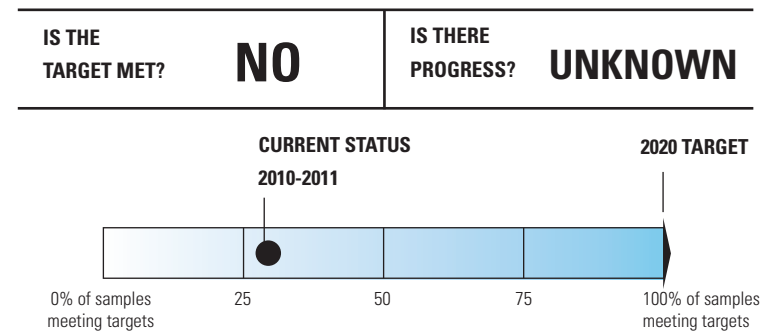


PAHs are tracked in fish by measuring byproducts (metabolites) of the compounds in their body fluids (in Pacific herring), or by measuring liver disease caused by PAH exposure (in English sole). PAHs levels in herring, a water-column species, from Central and Southern Puget Sound are similar to those of some urban English sole, a bottom-dwelling species. PAH levels in both species from these areas are cause for some concern. However PAH-related liver disease has declined to near background levels in one urban area (Elliott Bay).

#### Contaminant Type 4

#### Endocrine Disrupting Compounds (typically from pharmaceuticals, personal care products, but also from a wide range of other chemicals)

##### PROGRESS:



Endocrine disrupting compounds (EDCs) are chemicals that alter the normal hormonal system of fish, often resulting in problems related to growth or reproduction. EDCs have been evaluated in two species, English sole (adults) and Chinook salmon (juveniles). EDC-related feminization of male English sole was observed at five of six sampled locations, and in juvenile Chinook salmon from three of four sampled locations.

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effects of PAHs in the ecosystem may be significant but are currently not monitored. Of the effects represented by this indicator, we have seen a dramatic decline in PAH-related liver disease from prevalence rates of over 30% to less than 10% in English sole from Elliott Bay, one of Puget Sound's most highly contaminated bays. The reason for this recovery is unclear, but could be related to sediment cleanup, removal of creosote-treated pilings, or control of new inputs to the bay.

Not enough monitoring has been conducted yet to fully evaluate progress towards the target of reducing Endocrine Disrupting Compounds (EDCs). These chemicals originate from a huge range of sources including pharmaceuticals, personal care products, plastics, other industrial, agricultural or household products, and some of the chemicals described above. EDC effects were observed in fish, primarily as a trend towards feminization of males, in most places where English sole and juvenile salmon were sampled. Only one status survey has been conducted for these species so far. Unlike the pollutants above, EDC effects have been observed in fish from waters surrounded by rural areas. Many of these chemicals can be introduced to aquatic systems via wastewater.

### What are These Indicators?

#### *Indicators*

Each of the Toxics in Fish indicator metrics begins with a measure of the degree to which fish are exposed to toxic contaminants. In most

cases this means measuring the chemicals in fish tissues, in the form of "tissue residues". In some cases fish systems can break down or metabolize the chemicals, in which case the pollutants don't accumulate in their bodies. In these cases chemists measure "metabolites" of the chemicals, usually in the bile or blood of the fish.

In order to understand the potential harm these chemicals may cause, these metrics also incorporate an understanding of the "health effects threshold" of each chemical for each species. This is the level of contamination an individual can tolerate before it experiences some health effect. The combination of knowing what contaminant levels the fish is exposed to with its tolerance for a chemical provides a guide for selecting recovery targets.

In some cases it is easier to measure contaminant-induced disease or other health impairment directly. Examples of these metrics in the Toxics in Fish Indicator are PAH-related liver disease and EDC-related reproductive impairment in English sole. In these cases it is possible to observe recovery of fish health directly, after exposure to the contaminant is removed from the fish's habitat.

### *The Contaminant Monitoring Program*

The Washington Department of Fish and Wildlife monitors toxic contaminants in fish and other organisms, as a member of the Puget Sound Ecosystem Monitoring Program (PSEMP). This program has tracked the indicator metrics described above for several species in the

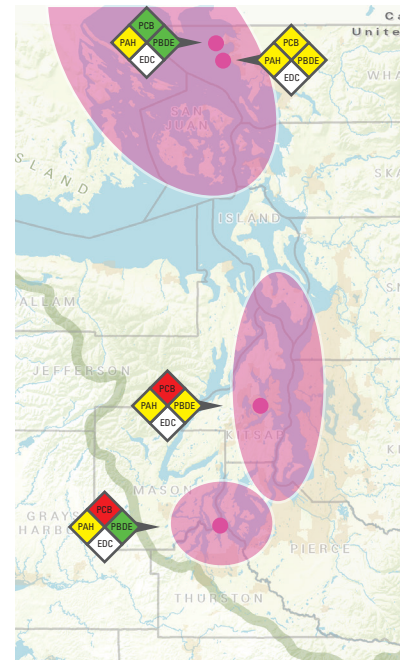
ecosystem, in addition to a number of chemicals not covered here. In addition, the PSEMP Toxics in Fish Unit has conducted a number of focus and diagnostic studies, along with partners including NOAA Fisheries, to develop new markers and investigate contaminants in the food web.

## Interpretation of Data

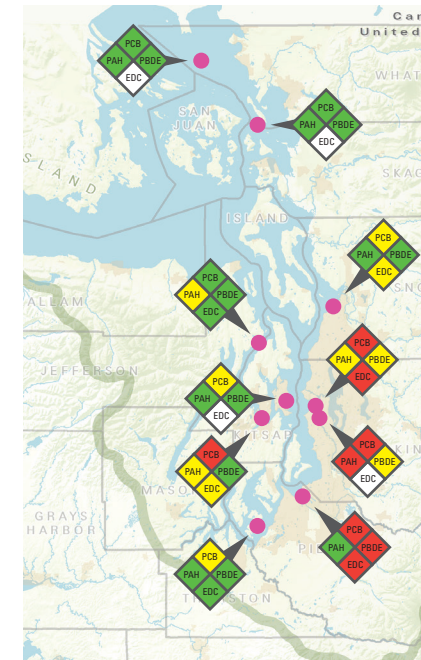
The Indicator metrics provided in this summary simplify a highly complex relationship between exposure of organisms to pollutants, and the effects such exposure might have on their health. Toxic contaminants in Puget Sound are found in fish throughout the ecosystem – not just in urban areas, and not just in bottom-dwelling fish. In addition, many contaminants accumulate in fish as they age. Some of these “bioaccumulative” contaminants also move up the food chain, increasing to high concentrations in apex predators. It is important to interpret data with reference to where the fish live, where they were sampled, their age, and their position in Puget Sound’s food web.



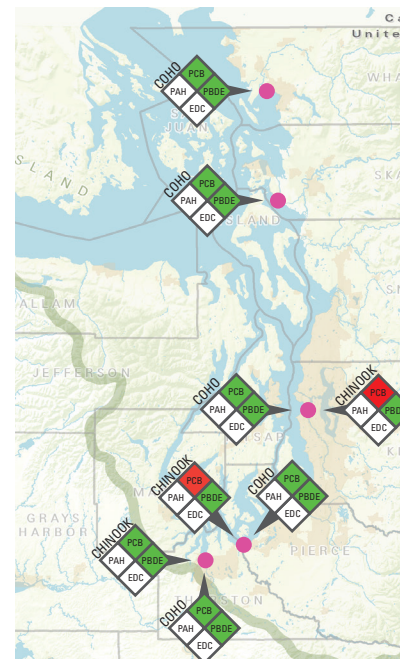
### Pacific Herring



### English Sole



### Adult Chinook and Coho Salmon



### Juvenile Chinook Salmon

